Chapter 3

SIGNALS

Section 3.1

SIGNALIZED INTERSECTION FLASHING MODE OPERATION AND FLASHING BEACONS

3.1.1 DEFINITIONS

(1) Flashing Beacon. A Flashing Beacon is a highway traffic signal with one or more signal sections that operates in a flashing mode. It can provide traffic control when used as an intersection control beacon or as a warning beacon in alternative uses.

(2) Flashing Operation of Traffic Control Signals:

(a) Non-Programmed Flashing Mode Operation. The automatic transfer from a signalized intersection's normal mode operation (stop and go, steady red-yellow-green displays) to flashing mode operation (stop or caution, flashing red-yellow, or red indications) caused by a malfunction of the signal controller, a conflict in signal displays or manual selection of the flashing mode operation by maintenance or police personnel.

(b) Programmed Flashing Mode Operation. The automatic transfer from a signalized intersection's normal mode operation (stop and go, steady red-yellow-green displays) to flashing mode operation (stop or caution, flashing red-yellow or red indications) during set times during the day.

3.1.2 RECOMMENDATIONS FOR SIGNALIZED INTERSECTIONS

3.1.2.1 Programmed Flashing Mode Operation

Flashing operation is both energy and operationally efficient and is encouraged when consistent with the following recommendations:

(1) Flashing yellow/red operation may be used when two-way traffic volumes on the main street are below 200 vehicles per hour.

(2) Flashing yellow/red operation may be used during any hours of the day or night when ***MUTCD Signal Warrants #1 and #2*** are not met and where the two-way main street volume is greater than 200 vehicles per hour, provided the ratio of main street to side street volume is greater than 4:1.

(3) Signal operation should be changed to regular operation if crash pattern or severity increases or there is an increase in conflicts.

(4) A **speedway** effect can be avoided and uniform speeds obtained by maintaining sufficient signals cycling through steady red, green and yellow at proper spacing so as to provide signal progression at an appropriate speed.

(5) Traffic signals should be put on flashing operation primarily at simple traffic signal controlled intersections where the side street drivers have an unrestricted view of approaching main street traffic. Intersections with more than four legs, skewed intersections (greater than 15 degrees), or railroad preempted signals should not be considered for flash.

(6) Flashing should be restricted to no more than 3 separate periods in a 24-hour period.

3.1.2.2 Non-Programmed Flashing Mode Operation

All signalized intersections shall automatically transfer to flashing mode immediately (no clearance interval) whenever a malfunction occurs during the normal mode operation of the signalized intersection.

3.1.3 APPLICATION REQUIREMENTS FOR SIGNALIZED INTERSECTION

The signal flashing mode and start-up sequence shall be as follows for:

Yellow-Red Flashing Mode:

(1) **Main Street.** Flashing yellow during flashing mode, then steady green on start-up sequence.

(2) **Protected Left Turns.** Flashing red during flashing mode, then steady red on start-up sequence. Protected left turn signals should carry all arrow indications.

(3) **Side Street.** Flashing red during flashing mode, then steady red on start-up sequence.

Red-Red Flashing Mode:

(1) **Main Street.** Flashing red during flashing mode, then steady green on start-up sequence.

(2) **Protected Left Turns.** Flashing red during flashing mode, then steady red on start-up sequence. Protected left turn signals should contain all arrow indications.

(3) **Side Street.** Flashing red during flashing mode, then steady red on start-up sequence.

3.1.4 HEADS TO BE FLASHED

Section 4D.30 of the MUTCD requires all signal faces on an approach to be flashed when the signal is in flashing mode operation. Therefore, a left or right turn signal not illuminated during flashing mode operation is unacceptable. ***Section 4D.30 of the MUTCD*** requires the flashing of red or yellow arrow indications.

Pedestrian signal indications (WALK and DON'T WALK) shall not be illuminated during flashing mode operation at signalized intersections.

3.1.5 FLASHING INDICATION COLORS

(1) The color to be flashed, red or yellow circular indication, or arrow indications shall be determined as follows:

(a) Each approach or separately-controlled turn movement that is controlled during normal stop-and-go operation shall be provided with a flashing display.

(b) All signal faces on an approach shall flash the same color, either yellow or red circular or arrow. However, separate signal faces for separately-controlled turn movements may be flashed as described in ***Section 4D.30 of the MUTCD***. Flashing yellow indications for through traffic do not have to be shielded or positioned to prevent visual conflict for drivers in separately-controlled turn lanes; however, shielding for separate protected turn movements shall be in accordance with ***Sections 4D.22, 4D.23, and 4D.24 of the MUTCD***. .

(c) When a signal face consisting entirely of arrow indications is to be put on flashing operation, or when a signal face contains no circular indication of the color that is to be flashed, the appropriate red or yellow arrow indication shall be flashed.

(d) When a signal face includes both circular and arrow indications of the color that is to be flashed, only the circular indication of that color shall be flashed. A 5-section head cluster shall be flashed the same color as the approach through lanes. Only circular red or circular yellow indications shall be flashed in a flashing mode operation.

(e) No steady green indication or flashing yellow indication shall be terminated and immediately followed by a steady red or flashing red indication without the display of the steady yellow change indication; however, transition may be made directly from a steady green indication to a flashing yellow indication. This applies to both the circular and arrow indications. The transition from stop-and-go to flashing operation, when

the transition is initiated by a signal conflict monitor or by a manual switch, may be made at any time.

(2) **Main Street, Through Traffic.** From flashing yellow to steady green.

(3) **Main Street, Separate Left Turn.** From flashing red to steady red.

(4) **Side Street, Through Traffic.** From flashing red to steady red.

(5) Green arrow indications which are continuously illuminated during normal operations should be continually illuminated during flashing mode operation.

3.1.6 APPLICATION REQUIREMENTS FOR FLASHING BEACONS

(1) All existing flashing beacons are considered to meet the ***MUTCD*** requirements whether they are single or dual indicated.

(2) However, all new or replacement intersection control beacon installations shall be designed and installed with dual indications. Wherever practical, the dual indications shall both be positioned laterally within each approach width to the intersection. For example, a four-way beacon assembly over each side of a divided four-lane highway does not meet this requirement. In no instance shall intersection control beacon indications on an approach be closer than 8 feet apart measured horizontally.

3.1.7 OPERATION OF FLASHING BEACONS

(1) **Intersection Control Beacons.** Dual indications for intersection control beacons displaying horizontally aligned red indications shall be flashed simultaneously. Alternate flashing of dual horizontally aligned red indications is reserved for highway approaches to a railroad. Two vertically aligned red signal indications shall be flashed alternately. Refer to ***Section 4L.02 of the MUTCD***.

(2) **Warning Beacons.** Warning beacons typically are installed at obstructions or to emphasize warning signs. These may be singular or dual indications and may be flashed alternately or simultaneously. Refer to ***Section 4L.03 of the MUTCD***.

Section 3.2

GUIDELINES FOR LEFT TURN TREATMENT

3.2.1 PURPOSE

This guideline can be used to determine the selection of the following types of left turn treatments, as defined in ***Section 4D.17 of the MUTCD***:

- Permissive Only Mode
- Protected/Permissive Mode
- Protected Only Mode
- Split Phasing (each direction alternatively has both left turn green arrow and circular green)

Option:

(a) A flashing YELLOW ARROW signal indication may be displayed to indicate a permissive left-turn movement in either a protected/permissive mode or a permissive only mode of operation.

(b) It is not necessary that the left-turn mode for an approach always be the same throughout the day. Varying the left-turn mode on an approach among the permissive only and/or the protected/permissive and/or the protected only left-turn modes, during different periods of the day is acceptable.

3.2.2 LEFT TURN SIGNAL PHASING

(1) If the need for left turn phasing on an intersection approach has been firmly established, the following guidelines should be used to select the type of left turn phasing to provide. Sound traffic engineering judgment should be exercised in applying these guidelines.

(2) A protected/permissive mode should be provided for all intersection approaches that require a left turn phase unless there is a compelling reason for using another type of left turn phasing. If the decision between providing protected/permissive or protected only mode is not obvious, the traffic engineer should initially operate the left turn phase as protected/permissive mode on a trial basis. If satisfactory operations result, the protected/permissive mode should be retained. If unsatisfactory operations result, the protected/permissive mode should be converted to protected only mode.

(3) A protected only mode shall be provided for an intersection approach if any of the following conditions exist:

(a) Two or more left turn only lanes are provided.

(b) Geometric conditions and resulting sight distance necessitate protected only mode.

(c) The approach is the lead portion of a lead/lag intersection phasing sequence.

(d) The use of offset left turn lanes to the degree that the cone of vision requirements in ***Section 4D.13 of the MUTCD*** for the shared signal display cannot be met.

(4) A protected only mode may be considered if any of the following conditions exist:

(a) Speed limit of opposing traffic is higher than 45 mph.

(b) Left turn traffic must cross three or more lanes of opposing through traffic.

(c) A protected/permissive mode is currently in use and the number of left turn angle crashes caused by left turn drivers on this approach exceeds six per year.

(d) Unusual intersection geometrics exist that will make permissive left turning particularly confusing or hazardous, such as restricted sight distance.

(5) A permissive/protected mode can be used effectively for some intersection approaches if the traffic engineer feels that the advantage to be gained in better progression, as demonstrated in a traffic signal analysis computer program, is worth the violation of driver expectancy. However, use of this type of left turn phasing should be limited and should be restricted to only the following situations which will not create a left-turn trap:

(a) T-intersections where opposing U-turns are prohibited.

(b) Four-way intersections where the opposing approach has prohibited left turns or protected left turn phasing.

(c) Four-way intersections where the left turn volumes from opposing approaches do not substantially differ throughout the various time periods of a normal day, so that overlap phasing is not beneficial or required.

(6) Split phasing can be used effectively if any of the following conditions apply:

(a) Opposing approaches are offset to an extent that simultaneous left turns from opposing directions would be impossible or hazardous.

(b) Left turn volumes are extremely heavy on opposing approaches and both are nearly equal to the adjacent through movement critical lane volume.

(c) Left turn volume is extremely heavy on an approach that does not include a separate left turn lane.

(d) Drivers are permitted to turn left from more than one lane, but drivers are also permitted to use the right-most left turn lane as a through lane.

3.2.3 LEFT TURN SIGNAL DISPLAYS

The following are the left turn signal displays as referenced in ***Section 4D.17 of the MUTCD*** to be used with the various types of left turn phasing.

(1) **Protected/Permissive Mode**. A 5-section signal display centered over the lane line between the left turn lane and the left-most through lane should be used. The 5-section signal display could serve as one of the two required through traffic signal heads. No supplemental signing should be provided.

(2) **Protected Only Mode with a single left turn lane**. A 3-section vertical signal head from top to bottom -- (or left to right in a horizontally-aligned face) left turn red arrow, left turn yellow arrow, left turn green arrow) should be centered over the left turn lane.

(3) **Protected Only Mode with two or more left turn lanes**. At least two 3-section vertical signal heads (or left to right in a horizontally-aligned face) as described in the paragraph above should be used with one centered over each left turn lane.

(4) **Split phasing**. A 5-section signal display centered over the lane line between the left turn lane and the left-most through lane should be used. The 5-section signal display could serve as one of the two required through traffic signal heads. No supplemental signing should be provided.

3.2.4 SIGNAL DISPLAY FOR EXCLUSIVE LEFT TURN LANE

A 3-section (red, yellow, and green) signal face shall not be placed over, and/or devoted to, an exclusive left turn lane, unless the signal phasing sequence provides a protected left turn movement during the cycle.

3.2.5 LEFT TURN PHASES FOR SEPARATED LEFT AND THRU LANES

(1) Left turn lanes at signalized intersections that are separated from through lanes by raised or painted islands may be operated as protected only mode, as protected/permissive or permissive only mode. If protected/permissive mode is

used, the 5-section signal display should be placed overhead on the lane line between the adjacent through lane and the island so as to be obvious that the signal display is shared. In all cases, the cone of vision requirements in ***Section 4D.13 of the MUTCD*** shall be met. Below is an illustrative example using standard lane widths on a 4-lane divided highway. A corresponding table for maximum allowable island width (without shifting the signal head) for the indicated signal head distance from stop line is given.

Figure 3.2-1. Signal Head/Left-turn Treatment

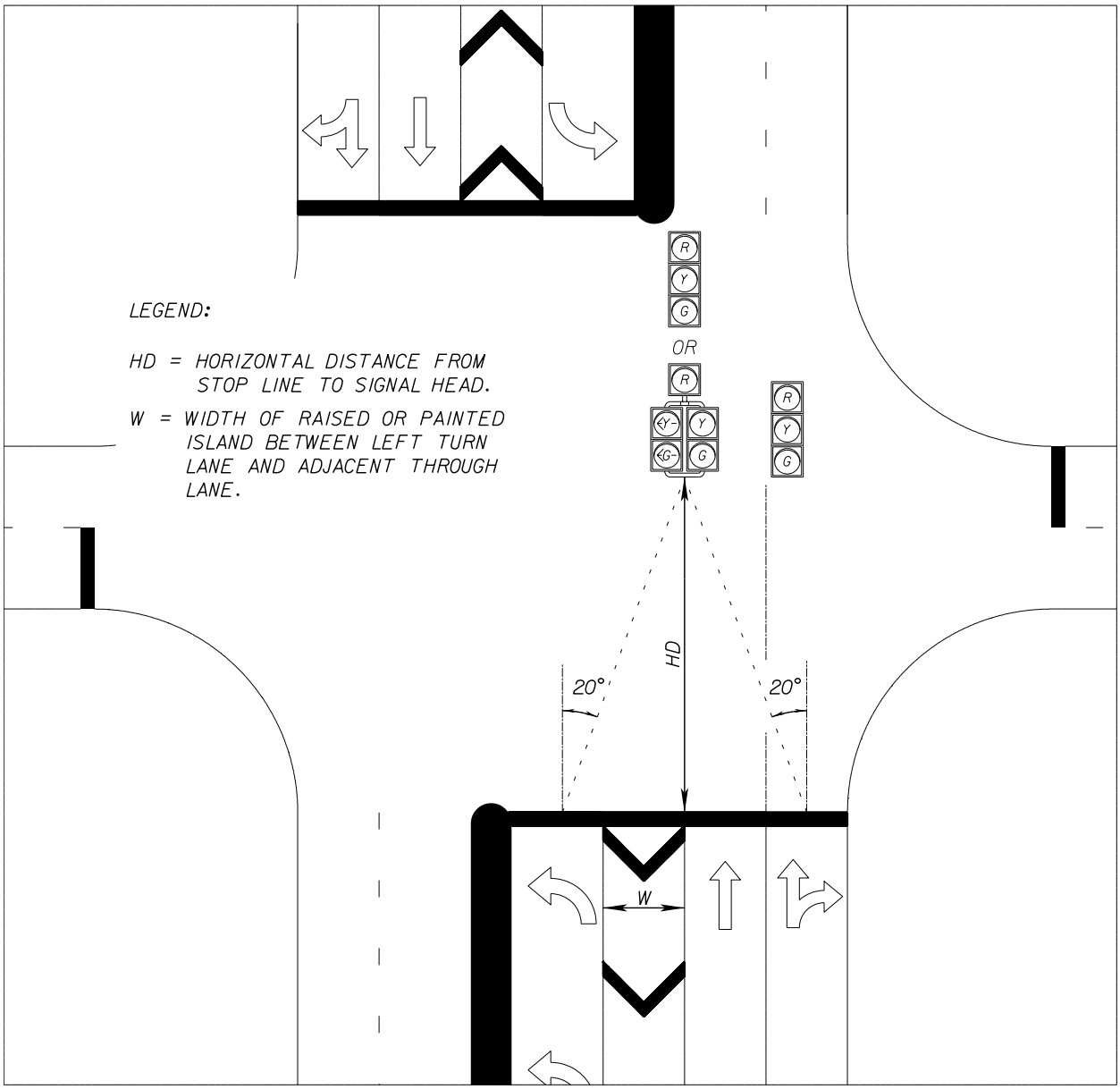


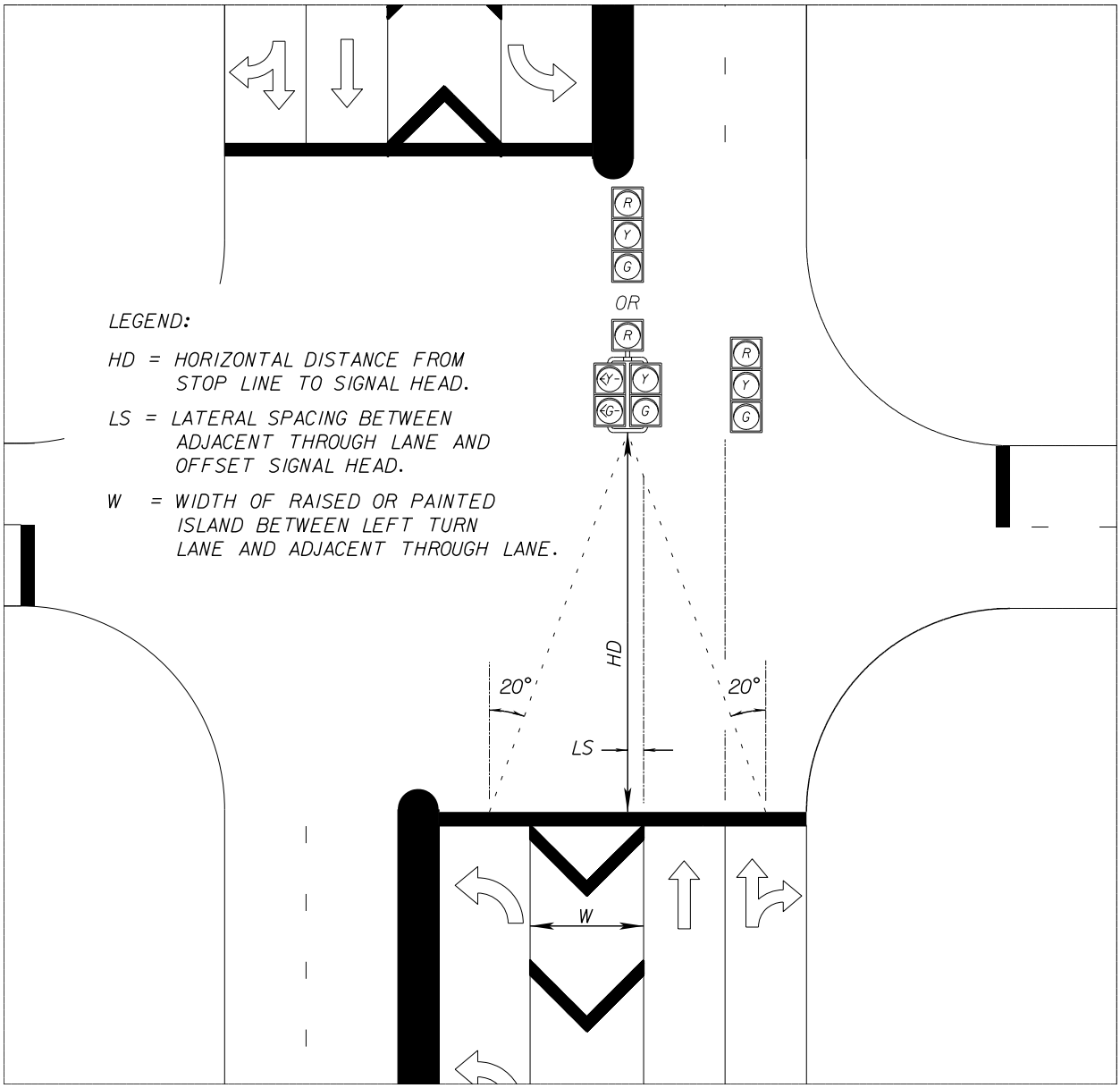
Table 3.2-2. Maximum Width of Hatched-Out Area without Shifting Signal Head

Horizontal Distance	Width
40	8
50	12
60	15
70	19
80	23
90	26
100	30
110	34
120	37
130	41
140	44
150	48

(2) Signal faces containing circular green signal indication for a permissive only left-turn should not be located above an exclusive left-turn lane or the extension of the lane, nor should they be post-mounted on the far side median in front of the left-turn lane. permissive only left turn signal displays shall not be provided in an exclusive left turn signal face. If the separation or geometric conditions of the offset left turn lane is such that the cone of vision would not be met with a shared signal head positioned on the lane line adjacent to the nearest through lane, the shared signal face may be offset to the left from the adjacent through lane line such that the required cone of vision is still met for the right most through lane and for the left turn lane. This lateral offset spacing should be used only after other options such as increasing the horizontal distance to the signals heads has been considered and placed so as to be obvious that the signal display is shared. The lateral offset spacing of the shared signal head from the adjacent through lane generally should not be greater than one half the width of the island (½ W).

(3) If the lateral shift is too great, the cone of vision may not be adequate for the driver in the right most through lane. Where the cone of vision cannot be met, protected only mode must be used. This may be due to a large parallel offset left turn lane or due to a tapered or curved offset left turn lane.

Figure 3.2-3. Left Turn Lane Signal Head Shift



3.2.6 PERMISSIVE ONLY MODE IN MULTI- LEFT TURN LANE APPROACHES

A permissive green interval for two or more left turn lane approaches shall not be used.

Section 3.3

SCHEDULING TRAFFIC SIGNAL STUDIES AND FUNDING ARRANGEMENTS

3.3.1 PURPOSE

To establish criteria for responding to requests for traffic signal installations, for funding and implementation arrangements for warranted signals and scheduling related studies to determine need.

3.3.2 GENERAL

Since the Department is charged with the responsibility to erect and maintain a uniform system of traffic signals and other traffic control devices for regulation, control, guidance, and protection of traffic on the State Highway System, there is need to provide uniformity in responding to requests for signals and in the scheduling and conducting of traffic studies to determine signal needs.

3.3.3 RESPONSE TO SIGNAL REQUESTS AND SCHEDULING TRAFFIC SIGNAL STUDIES

(1) The District Traffic Operations Office shall objectively review all requests for traffic signal installations received by the Department against existing information and local knowledge of the intersection before agreeing to commit resources for a detailed traffic study. This initial screening may require a brief site visit to view the field conditions. During the initial screening, all data shall be recorded in writing and kept on file. An attempt shall be made to relate all data and analysis to standards set forth in the ***MUTCD***. If the initial screening results in a decision to conduct a signal warrant study, the appropriate ***District Traffic Operations Office*** should contact the local government traffic engineering agency, advise them of the Department's decision, and obtain their views and input.

(2) If the initial screening results in a decision to not consider signalization or further study, the ***District Traffic Operations Office*** shall document the reasons and advise the requestor of the findings with a copy to the local government traffic engineering agency. Although local government concurrence is desirable, it is not a prerequisite for committing Department resources to a full signal warrant study.

(3) The ***District Traffic Operations Office*** shall normally conduct signal warrant studies for proposed signal installations on the State Highway System. However, a local government traffic engineering agency may conduct such studies and submit them to the ***District Traffic Operations Office*** for review. All studies

shall be conducted in accordance with the procedure and standards prescribed in this document and shall be signed and sealed by a professional engineer.

(4) Formal *legal* resolutions from local agencies may form the basis of their concurrence in the need for a traffic signal study. However, such documents should not be required by the Department as a prerequisite to scheduling the study. Additionally, the availability of implementation funds should not be a prerequisite to assessing traffic signalization needs (conducting a study).

(5) The ***District Traffic Operations Office*** shall keep a log of requests for traffic signal studies and their disposition. To the extent practical, a priority system utilizing the request date, traffic volumes, accident experience, and the level of local government interest should be used to schedule traffic signal studies.

3.3.4 TRAFFIC SIGNAL STUDIES AND ENGINEERING

(1) Department of Transportation staff, local agency engineers or qualified consulting engineers may perform studies for traffic signals and provide any required engineering services for the preparation of implementation plans and specifications for proposed traffic signals on the State Highway System. However, the Department is responsible for requiring and overseeing such work.

(2) Traffic signal studies shall be made in accordance with Department ***Topic No. 750-020-007, Uniform Traffic Engineering Studies***, particularly, ***Chapter 12 of the Manual on Uniform Traffic Studies (MUTS)***, referred therein. Plans and specifications, if required, shall be prepared in accordance with established Department procedures.

(3) Traffic signal studies or engineering analyses conducted for new, or proposals for significantly revised, private access points to major traffic generators shall be conducted by qualified traffic engineers at no cost to the Department. Except under unusual circumstances, these studies and/or analyses shall be part of the ***Driveway Permit Application*** as per the requirements of ***Rule 14-96***. These studies shall, in addition to evaluating the need for signal control at unsignalized intersections, also consider enhanced features at existing signalized intersections, as appropriate. Such study and report shall be signed and sealed by a professional engineer. Likewise, engineering costs associated with the preparation of implementation plans and specifications should also normally be borne by the developer. There may be instances where the Department determines that specific critical design requirements make it essential that the engineering work be performed by Department forces. In such instances, the District Secretary may direct that the engineering work be done by the Department at no cost to the developer.

(4) Studies and engineering at existing private access points which may be required as a result of normal traffic growth are usually made by qualified traffic engineers by the requestor. In extraordinary situations the Department may elect to do so.

3.3.5 FUNDING ARRANGEMENTS FOR WARRANTED NEW SIGNAL INSTALLATIONS

(1) New traffic signal installations on the State Highway System may be funded from private, local, state, or federal funds, or any combination of such funds.

(2) The developers shall totally fund the installation of any new traffic signal and/or the enhancements of any existing traffic signals when these improvements are requirements specified in a new or revised Driveway Permit or local government Development Order. If proposals to provide signalization or modify existing signalization is above the minimum required by Permit or Development Order and provides a betterment to the State Highway System substantially beyond mitigation for development impacts, the Department's District Secretary may determine an appropriate financial participation formula and assign percentages of participation to the developer in consideration of the specific conditions at each site.

(3) Although signal installation on the State Highway System is the responsibility of the Department, local governments may contribute, on a voluntary basis, a portion, or all of the cost of signal installation depending upon specific cooperative arrangements worked out between the Department's District Offices and the local agency. Local funds are most often utilized in these cooperative efforts to advance the implementation schedule of a warranted traffic signal. When local funds are accepted by the Department, a formal joint project agreement executed by both parties is necessary.

(4) Most local governments in Florida's urban areas have qualified traffic engineering organizations with experienced traffic signal field crews and many new signals have been installed on the State Highway System using local agency installation crews with control hardware supplied by the Department. Where the local agency is agreeable to this procedure (most are because of their maintenance and operational involvement in these sites), this technique should be encouraged. No formal agreement is necessary since no money is changing hands; however, a letter from the local agency agreeing to install Department supplied hardware should be obtained.

3.3.6 OTHER CONSIDERATIONS

(1) Prior to purchase, use, or installation, traffic signals must comply with provisions of the FDOT Approved Product List Submittal Process. For more information visit ***http://www.fdot.gov/programmanagement/ProductEvaluation/QPL/SubmittalProcess.shtm.***

(2) Prior to installation of traffic signals, compliance with ***Topic No. 750-010-022, Traffic Signal Maintenance Agreements***, is necessary.

Section 3.4

EMERGENCY TRAFFIC CONTROL SIGNALS

3.4.1 PURPOSE

To provide guidance for warranting, designing, and operating emergency traffic control signals at locations where emergency vehicles, most commonly fire trucks, need special traffic signal assistance to egress onto the street system.

3.4.2 BACKGROUND

The Department's district offices often receive local public agency requests for traffic signal control for the departure of emergency vehicles. This section was developed to give comprehensive guidance to determine if the signals are warranted.

3.4.3 PROCEDURE

The need for an Emergency Traffic Control Signal shall be considered if an engineering study finds that one of the following warrants are met:

(1) Minimum Traffic Volumes (Both directions of travel, based on signal warrant #2), as shown in ***Table 3.4-1***.

Table 3.4-1. Minimum Traffic Volumes

Roadway	Peak Hour	or	24 Hours
2-Lane	750 VPH		7500 ADT
4-Lane	900* VPH		9000* ADT
6-Lane or more	1200* VPH		12000* ADT

*Values shall be increased by 1/3 when arterial has traffic signal system coordination with signals located within 1000 feet in both directions from the emergency signal location.

(2) When the geometric design of the arterial and emergency vehicle facility is such that the vehicle when returning must *back in*, and to do so must block traffic when performing this maneuver and the traffic volume and speeds are such that the use of emergency vehicle lights and flaggers have been ineffective in controlling traffic.

(3) When the location of the emergency vehicle driveway consistently conflicts with the normal traffic queue from an adjacent signalized intersection. The use of DO NOT BLOCK INTERSECTION ***(R10-7)*** sign should be considered in conjunction with the emergency signal installation.

(4) On all approaches when vertical or horizontal curvature or other obstructions do not provide adequate stopping sight distance for traffic approaching an emergency vehicle driveway.

3.4.4 CONFIGURATION AND OPERATION OF EMERGENCY TRAFFIC CONTROL SIGNALS

(1) ***Section 4G.03 of the MUTCD*** defines the operational requirements for a *mid-block* location of an emergency signal. The ***MUTCD*** allows either a steady green or flashing yellow operation of signal heads between emergency vehicle actuations. These choices of operation, combined with limited details for signal configuration requirements have resulted in a lack of uniformity of emergency signal design and operation within the State, therefore, the following criteria shall be followed.

(2) Based on requirements contained in ***Chapter 4G of the MUTCD***, the following criteria for emergency traffic control signals shall be followed for new or reconstructed installations.

(a) Dual indications shall be provided for each roadway approach. A minimum of one signal face shall be installed for the emergency vehicle driveway but two indications are preferable.

(b) If the emergency service is located off the main roadway and emergency vehicles access the main roadway via a public access street, emergency signals may be erected at the intersection of these roadways. If this practice is followed, dual indication shall be used on the public access street, with the signals resting on the flashing red indication.

(c) Mid-block emergency signals shall be operated as flashing yellow between emergency vehicle actuations. Roadway signal head configuration shall consist of three sections and shall be operated as shown in ***Figure 3.4-2***. (The use of special technological signal devices may be selected, i.e., strobe signals, LED, or solar power. These devices may require temporary permitting prior to installation.)

(d) Signal operation at intersections which are pre-empted by emergency vehicles entering the roadway near or at the intersection should be designed on an individual basis.

(3) It is not practical to outline all possible situations which may be encountered in the field. Such factors as emergency vehicle route distance between the intersection and emergency vehicle driveway, intersection geometrics, number of lanes, normal queue length, traffic volumes, etc., should be considered.

3.4.5 EMERGENCY SIGNAL SIGN *(R10-13)*

(1) As emergency signals are installed at locations along major arterials where emergency vehicles enter the roadway, the EMERGENCY SIGNAL sign ***(R10-13)***, shall be placed on the span wire or mast arm to identify the purpose of the signal to the driver.

(2) The EMERGENCY SIGNAL sign ***(R10-13)*** shall be legible at all times, shall be mounted adjacent to each signal face, and shall be located between the dual signal indications on each roadway approach.

(3) No sign is required for the emergency vehicle driveway approach.

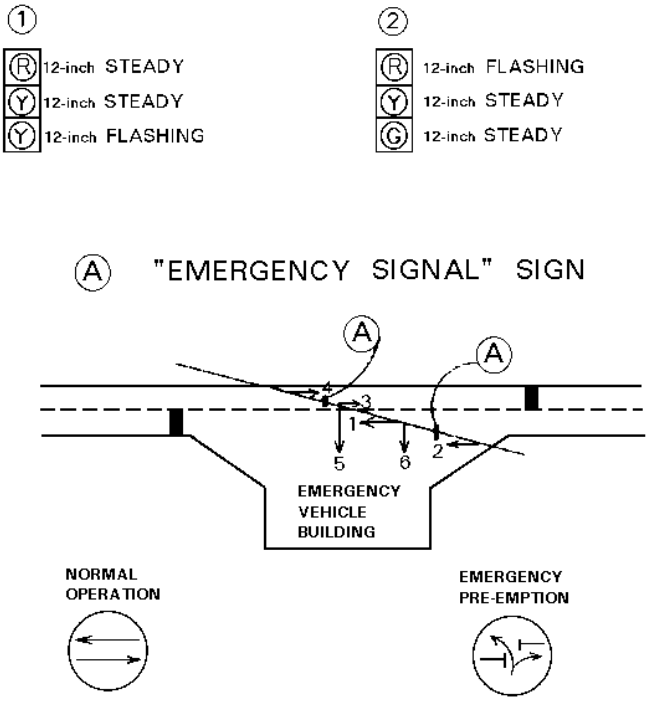
3.4.6 OTHER REQUIREMENTS

(1) A controller timing chart shall be a part of the contract plans.

(2) A Maintenance Agreement shall be required for all Emergency Signals on the State Highway System.

(3) A signal timing study is required to determine proper clearance intervals.

Figure 3.4-2. Mid-Block Emergency Signal Operation



SIGNAL	NORMAL OPERATION	CHANGE TO EMERGENCY PRE-EMPTION	EMERGENCY PRE-EMPTION	CHANGE FROM EMERGENCY PRE-EMPTION	RELEASE
1,2,3,4	G or FY	Y	R	R	G or FY
5,6	BLANK	BLANK	G	BLANK	BLANK

Section 3.5

TRAFFIC SIGNAL MAST ARM SUPPORT BOUNDARIES

3.5.1 GENERAL

The ***Department's Plans Preparation Manual, Topic No. 625-000-007, Volume 1 – Chapter 7*** requires that all traffic signals installed on the State Highway System that are within the Mast Arm Structures Boundary shall be supported by mast arms.

3.5.2 IMPLEMENTATION

3.5.2.1 Mast Arm Structures Boundary Maps

The mast arm structures boundary map follows an alignment of state roads that are parallel to an approximate ten mile distance to the coastline. Official mapping of this boundary is maintained on a Map Info-Base by the State Traffic Engineering and Operations Office. Links to current district maps are provided below:

District 1
District 2
District 3
District 4
District 5
District 6
District 7

Section 3.6

STANDARDIZATION OF YELLOW CHANGE AND RED CLEARANCE INTERVALS FOR SIGNALIZED INTERSECTIONS

3.6.1 PURPOSE

The purpose of the yellow change and red clearance intervals is to provide a safe transition between two conflicting traffic signal phases. The function of yellow change interval is to warn traffic of an impending change in the right-of-way assignment and the function of the red clearance interval is to provide additional time following the yellow change interval to clear the intersection before conflicting traffic is released. The Manual on Uniform Traffic Control Devices (***MUTCD***) states that a yellow change interval should have a minimum duration of 3 seconds and a maximum duration of 6 seconds and a red clearance interval should have duration not exceeding 6 seconds. The intent of this section is to provide a standard for uniform application of yellow and red intervals.

All new signal installations, intersections that have a Traffic Infraction Detectors installed, any signal that has signal phasing changes, geometric changes affecting the timing or phasing, or corridor re-timing projects must comply with these standards immediately upon implementing timing changes. All other existing signalized intersections on the State Highway System must be in compliance with standards of this section by June 30, 2015.

3.6.2 STANDARD

(1) ***Section 316.075(3)(a), F.S.*** states that no traffic control signal device shall be used which does not exhibit a yellow or "caution" light between the green or "go" signal and the red or "stop" signal. The Statute is silent on the yellow clearance interval duration and does not mention nor mandates the use of a red clearance interval.

(2) The Institute of Transportation Engineers (ITE) formula shall be used to calculate yellow change interval. Yellow change intervals shall not be lower than the values shown in Table 3.6-1 for a given posted speed limit (PSL) even if the ITE formula produces a lower value. Yellow change intervals calculated to be lower than 3.4 seconds shall be set at no less than 3.4 seconds. The yellow interval shall not exceed 6 seconds. Any yellow change intervals that are greater than the standard yellow change intervals presented in Table 3.6-1 of this section, for a given PSL, are allowed, but they shall be based on *MUTCD's Section 4D.26*, engineering practice and the ITE formula. However, for a given PSL, the yellow change intervals shall not be less than the standard values presented in Table 3.6-1.

(3) A Perception Reaction Time (PRT) of 1.4 seconds shall be used. Yellow change and red clearance interval times shall be rounded up to the nearest 0.1 second.

(4) Approach speed used in this section is the PSL for the approach being analyzed.

3.6.2.1 Yellow Change Interval

(1) Recent research has found that the 85th percentile PRT value was 1.33 seconds. Based on the research results, a PRT of 1.4 seconds shall be used.

(2) The Florida yellow change intervals shown in ***Table 3.6-1***, are computed using ***Formula 3.6-1*** **(**found in ***ITE's Traffic Engineering Handbook***) with a PRT of 1.4 seconds and a grade of 0%. These intervals are the required standard minimum values.

Table 3.6-1. Florida Yellow Change Interval (0.0 % Grade) Standards*

APPROACH SPEED (MPH)	YELLOW INTERVAL (SECONDS)
25	3.4
30	3.7
35	4.0
40	4.4
45	4.8
50	5.1
55	5.5
60	5.9
65	6.0
* For approach grades other than 0%, use ITE Formula.	

Formula 3.6-1

$$Y = t + \frac{1.47v}{2(a + Gg)}$$

Where:

Y = length of yellow interval, sec.
t = perception-reaction time (use 1.4 sec.)
v = speed of approaching vehicles, in mph.
a = deceleration rate in response to the onset of a yellow indication (use 10 ft/sec^2)
g = acceleration due to gravity (use 32.2 ft/sec^2)
G= grade, with uphill positive and downhill negative (percent grade /100)

3.6.2.2 Red Clearance Interval

A red clearance interval must be used. Providing adequate red clearance intervals can significantly impact intersection safety by reducing the probability of occurrence of right angle crashes, even if drivers run the red signal indication. The red clearance interval shall be

determined using engineering practices. The values are typically computed using ***Formula 3.6-2,*** found in ***ITE's Traffic Engineering Handbook***.

Formula 3.6-2

$$R = \frac{W + L}{1.47v}$$

Where:

R = length of red interval, sec.
W = width of the intersection, in feet, measured from the near-side stop line to the far edge of the conflicting traffic lane along the actual vehicle path.
L = Length of vehicle (Use 20 ft.)
v = speed of approaching vehicles, in mph.

The minimum red clearance interval shall be 2.0 seconds and the maximum red clearance interval should normally not exceed 6.0 seconds. Longer red intervals than the minimum 2.0 seconds can be used at the engineer's discretion where width of intersection, sight distance, complex intersections, crash history and any unique conditions exist that may warrant longer red times. The determination shall be based on engineering judgment. The National Cooperative Highway Research Program (NCHRP) Report 731 recommends using a modified ITE formula that allows for 1.0 second reduction due to reaction time delay from the conflicting movement. Therefore, a 1.0 second reduction may be made in the values computed from Formula 3.6-2 and applying engineering judgment. However, the red clearance interval shall be no less than 2.0 seconds.

Section 3.7

AUDIBLE PEDESTRIAN SIGNALS

3.7.1 PURPOSE

To establish criteria for the installation and operation of audible pedestrian signal heads on the State Highway System.

3.7.2 GENERAL

(1) ***Section 4E.09 of the MUTCD*** establishes the standards for which audible pedestrian signals shall be installed on the State Highway System. ***Section 4E.06*** also contains guidance and support that should be reviewed and considered on any audible signal installation request.

(2) The ***MUTCD*** does state that pedestrians with vision disabilities who cross streets at signalized intersections initiate their crossing when they hear the traffic in front of them stop and the traffic alongside them begin to move, corresponding to the onset of the green interval. This technique is effective at most signalized intersections; therefore, the vast majority of signalized intersections will not require any audible pedestrian signals.

3.7.3 PROCEDURE

(1) Any audible pedestrian signal that is installed on the State Highway System shall be reviewed and approved by the District Traffic Operations Engineer prior to installation.

(2) Requests for audible signal installations received from the public, maintaining agencies, or agencies and/or support groups for the visually impaired shall be reviewed by the District Traffic Operations Engineer with input, if necessary, from visually impaired agencies and/or support organizations to determine if the audible signal would be effective and/or safe for operation.

(3) An engineering study shall be conducted if the initial District Traffic Operations Engineer's review supports the installation of the audible pedestrian signal.

(4) The following criteria should be considered before approving an audible pedestrian signal.

- **(a)** Engineering study to assess the need.
- **(b)** Right on red movements.
- **(c)** Continuous right turn movements.

(d) Complexity of signal phasing.
(e) Complexity of intersection geometry.
(f) Traffic volumes during times when pedestrians might be present.
(g) Audible tones or sounds that may cause confusion.
(h) Verbal messages instead of tones or sounds.
(i) Vibrotactile pedestrian devices.
(j) Pushbutton or passive pedestrian detectors.
(k) Sufficient audible above ambient noise, 89db (decibles) maximum.
(l) Installations at locations with more than four lanes and/or greater than 35 MPH posted speed limit shall be given additional considerations for geometrics, operations, and pedestrian safety.
(m) Consideration for audible signal installations other than at mid-block locations (i.e. transit corridors or hubs) shall be installed only after review and approval by the District Traffic Operations Engineer.

(5) If the proposed location is a wide crossing where pedestrian storage is required in the median area, then an audible pedestrian signal installation is not recommended.

3.7.4 APPROVAL/DENIAL PROCESS

(1) The District Traffic Operations Engineer shall objectively review all requests for audible pedestrian signals received by the Department from an engineering study and/or local request before agreeing to approve the installation.

(2) The initial review may require a brief site visit to view the field conditions. During the initial screening, all data shall be recorded in writing and kept on file. An attempt shall be made to relate all data and analysis to standards set forth in ***Section 4E.09 of the MUTCD*.**

(3) If the initial review results in a decision not to consider the audible pedestrian signal head, the District Traffic Operations Engineer shall document the reasons and advise the requestor of the findings with a copy provided to local government's Traffic Engineering Office. Although local government concurrence is desirable, it is not a prerequisite for committing Department resources for an audible pedestrian signal installation.

Section 3.8

MARKED PEDESTRIAN CROSSWALKS AT MIDBLOCK AND UNCONTROLLED APPROACH LOCATIONS

3.8.1 PURPOSE

To establish criteria for the consistent installation and operation of marked pedestrian crosswalks at midblock and unsignalized intersections on the State Highway System.

3.8.2 GENERAL

(1) Marked crosswalks at uncontrolled approaches are intended to improve pedestrian connectivity and reduce instances of pedestrians crossing at random and unpredictable locations which can create confusion and add risk to themselves and other road users. Crosswalks may be used to facilitate pedestrian access and to concentrate pedestrian crossing activity to a safe and predictable location. Pedestrian crosswalks at uncontrolled approaches may be an appropriate tool where there is a documented pedestrian demand and the distance to the nearest controlled intersection crossing location would result in significant out-of direction travel for pedestrians.

(2) Marked crosswalks that are well located and thoughtfully designed can serve as a mechanism for improving pedestrian connections, community walkability, and pedestrian safety. However, they are not suitable for all locations and careful evaluation must be undertaken regarding expected levels of pedestrian crossing demand, safety characteristics of the crossing location, and design considerations for the crossing control type.

3.8.3 DEFINITIONS

(1) **Marked crosswalk**. Any portion of a roadway at an intersection or elsewhere distinctly indicated for pedestrian crossing by lines or other markings on the surface. Marked crosswalks serve to indicate to pedestrians a preferred route of travel to cross a street, highlight where motorists can expect pedestrians to cross, and designate a stopping location for motorists.

(2) **Midblock location**. Any location proposed for a marked crosswalk between intersections.

(3) **Pedestrian attractor**. A residential, commercial, office, recreational, or other land use that is expected to be an end destination for pedestrian trips.

(4) **Pedestrian generator**. A residential, commercial, office, recreational or any other land use that serves as the starting point for a pedestrian trip.

(5) **Pedestrian Hybrid Beacon**. A pedestrian actuated traffic control device that provides a dark indication to motorists until activated by a pedestrian, at which time a flashing yellow followed by a solid red indication is provided to motorists to direct them to stop. The solid red indication advances to a flashing red indication that allows motorists to proceed with caution once a pedestrian has cleared the crossing.

(6) **Rectangular Rapid Flashing Beacon (RRFB)**. A traffic control device consisting of two rapidly and alternately flashing rectangular yellow indications having LED-array based pulsing light sources that function as a warning beacon.

(7) **Two-stage marked crosswalk**. A marked crosswalk that is designed to require pedestrians to cross each half of the street independently, with the median serving as a refuge area for pedestrians to wait before completing the crossing.

(8) **Uncontrolled approach**. A portion of the roadway without stop or signal control, including midblock and unsignalized intersections.

(9) **Unmarked crosswalk**. The legal crossing area at an intersection connecting opposite sides of the roadway.

3.8.4 PROCEDURE

(1) Any marked crosswalk proposed for an uncontrolled approach on the State Highway System shall be reviewed and approved by the appropriate District Traffic Operations Engineer prior to installation.

(2) A request from a State agency or local government for a marked crosswalk on an uncontrolled approach shall be submitted to the appropriate District Traffic Operations Engineer. Non-governmental entities wishing to obtain authorization for a crosswalk at an uncontrolled approach location shall do so through the local government.

(3) If the District Traffic Operations Engineer's review of available information supports the installation of a marked crosswalk at an uncontrolled approach location based upon the criteria outlined in ***Section 3.8.5***, then the justification for the marked crosswalk must be documented.

(4) The criteria referenced in ***Section 3.8.5***, as documented in an engineering study, shall be met as a condition for approval of a proposed marked crosswalk at an uncontrolled location. The engineering study must include the following information:

(a) Field data to demonstrate the need for a crosswalk based upon minimum pedestrian volumes and availability of any alternative crossing locations that satisfy the criteria described in ***Section 3.8.5***. The ***Department's Manual on Uniform Traffic Studies (MUTS)*** provides additional information on obtaining Pedestrian Group Size and Vehicle Gap Size field data for use in making assessments of opportunities for safe crossings at uncontrolled locations.

(b) Potential links between pedestrian generators and attractors. This information is required for establishing the proposed crossing location or to confirm existing pedestrian crossing patterns.

(c) All safety considerations as described in ***Section 3.8.5(5)*** with respect to stopping sight distances, illumination levels, and proximity to intersection conflict areas.

(d) The proposed crossing location and corresponding signing, marking, and signal treatments (if applicable). A schematic layout should be provided over aerial photography or survey to show locations of signs, markings, and other treatments in proximity to existing traffic control devices.

(e) Any pedestrian-vehicle crash history within the vicinity of the proposed crosswalk that has occurred based upon a minimum of three years of data. Also, from field observation, document the number and nature of any pedestrian-vehicle conflicts.

(f) Transit stop activity data and the location of transit stops within the vicinity of the proposed crosswalk, as applicable.

(5) If the evaluation results in a decision not to consider the installation of a requested marked crosswalk, the District Traffic Operations Engineer shall document the reasons and advise the requestor of the findings. Meeting the minimum criteria outlined in this section does not guarantee approval of a request.

(6) Prior to the approval of a marked pedestrian crossing at an uncontrolled approach location, coordination is necessary between the appropriate District Traffic Operations Office and local agencies to determine and document responsibilities for maintenance of any proposed traffic control devices.

3.8.5 INSTALLATION CRITERIA AND CONSIDERATIONS

(1) Placement of marked crosswalks should be based upon an identified need and not used indiscriminately. Important factors that should be considered when evaluating the need for a marked crosswalk include:

(a) Proximity to significant generators
(b) Pedestrian demand
(c) Pedestrian-vehicle crash history
(d) Distance between crossing locations

(2) To be considered for a marked pedestrian crosswalk, an uncontrolled approach location shall meet all the criteria in ***Sections 3.8.5(3) and 3.8.5(4)***. An exception to this criterion is within a school zone, where there is no minimum pedestrian volume for a school crossing.

(3) Minimum Levels of Pedestrian Demand

(a) Any uncontrolled location under consideration for a marked crosswalk should exhibit (1) a well-defined spatial pattern of pedestrian generators, attractors, and flow (across a roadway) between them or (2) a well-defined pattern of existing pedestrian crossings. Generators and attractors should be identified over an aerial photograph to illustrate potential pedestrian routes in relation to any proposed marked crosswalk location.

(b) Sufficient demand should exist that meets or exceeds the thresholds for three days of data collection within a seven day period. An average day is generally considered a non-holiday weekday without a special event. Data collection should be based upon pedestrian volumes observed crossing the roadway outside a crosswalk at or in the vicinity of the proposed location, or at an adjacent (nearby) intersection. A bicyclist can be counted as a pedestrian if appropriate for the crossing.

The following minimum thresholds should be met when considering a new marked crosswalk at an uncontrolled approach:

- 20 or more pedestrians during a single hour (any four consecutive 15-minute periods) of an average day, or
- 18 or more pedestrians during each of any two hours of an average day, or
- 15 or more pedestrians during each of any three hours of an average day.

Some locations experience challenges related to pedestrians with slower crossing speeds. In those cases, children, older adults, and pedestrians with physical disabilities may be counted twice (2x) toward these volume thresholds. Judgment and care should be applied when estimating pedestrian categories. Children are generally under age 12 while older adults are typically 65 years or older.

(c) **Multi-Use Trail Crossings**

In order to promote the use of multi-use paths and reduce the impacts roadway crossings can create for pedestrians and bicyclists, crossing locations connecting a multi-use path on each side of a roadway are not subject to minimum pedestrian volume criteria listed above.

Proposed locations where a trail or multi-use path ends on one side of a roadway and a sidewalk or similar facility exists on the other side of the roadway must meet 50% of the minimum pedestrian volume threshold for installation. Such crosswalks are subject to removal if pedestrian volumes fall below half of this reduced threshold.

Care should be given to selecting the appropriate location and crossing treatments for multi-use trails.

(4) Minimum Location Characteristics

(a) A minimum vehicular volume of 2,000 Average Daily Traffic (ADT) along the roadway segment.

(b) Minimum distance to nearest alternative crossing location is 300 feet per the ***Department's Plans Preparation Manual, Vol. 1, Section 8.3.3.2***. An alternative pedestrian crossing location may be considered to be any controlled location with a STOP sign, traffic signal, or a grade-separated pedestrian bridge or tunnel that accommodates pedestrian movement across the subject roadway. A proposed crossing location that falls between 100 and 300 feet from an alternative existing crossing may be considered if more practical for pedestrian use; this justification must be documented in an engineering report.

(c) Marked crosswalks should not be installed mid-block where the spacing between adjacent intersections is less than 660 feet, consistent with the ***Department's Plans Preparation Manual, Vol. 1, Section 8.3.3.2***.

(d) The proposed location must be outside the influence area of adjacent signalized intersections, including the limits of the auxiliary turn lanes. Where an adjacent intersection is signalized, the design must ensure that the ends of standing queues do not extend to the proposed marked crosswalk location.

(5) Safety Considerations

For any proposed marked crosswalk, the location should be conducive to providing a sufficient level of pedestrian safety. The following conditions should be satisfied for existing crosswalks or, if not, should be achieved in conjunction with any implementation of the proposed marked crosswalk:

(a) The location for a marked crosswalk must provide adequate stopping sight distance. The ***Department's Plans Preparation Manual, Vol. 1, Section 2.7*** provides additional information for identifying appropriate stopping sight distance. Parking restrictions in the vicinity of the marked crosswalk may be necessary to meet required sight distance. Other optional treatments, including curb extensions, may also be considered for improving sight distance and reducing pedestrian crossing distance.

(b) If sidewalks connecting the crosswalk to established pedestrian generators and attractors are not already present, they should be provided. The ***Department's Plans Preparation Manual, Vol. 1, Section 8.3.1*** provides additional sidewalk design considerations.

(c) Crosswalk illumination shall be provided at all newly constructed uncontrolled approach crosswalks. However, there may be locations such as environmentally-sensitive areas or crosswalks serving facilities that are open only during daylight hours, where lighting may be omitted.

(d) At uncontrolled approach locations with vehicular volumes greater than 12,000 ADT or where crossing distances exceed 60 feet, a refuge island or raised median should be considered. Provide documentation where physical constraints prevent the accommodation of a median refuge. Roadway and safety conditions shall be taken into consideration in identifying whether the location is appropriate for a marked crosswalk. Median refuge areas shall meet Americans with Disabilities Act (ADA) requirements and the ***Department's Standard Plans, Index No. 522-002***.

(e) Consideration should be given to the location of nearby bus stops when locating a proposed pedestrian crossing. Marked crosswalk placement should seek to minimize conflicts with transit vehicles. Bus stops on the far side of a marked crossing are preferred. If feasible, bus stops can be relocated to better align with a proposed pedestrian crossing.

3.8.6 PEDESTRIAN CROSSING TREATMENTS

(1) Ten-foot wide minimum Special Emphasis Crosswalk markings shall be used for all marked crosswalks at uncontrolled approaches, as shown in the ***Department's Standard Plans, Index No. 711-001***.

(2) For many situations, a marked crosswalk alone may not be sufficient. Signs and pavement markings alone will not make crossings safer, nor will they necessarily result in more vehicles stopping for pedestrians. Other facility enhancements should be considered in conjunction with a marked crosswalk such as curb extensions, raised crosswalks, speed reduction treatments, additional signing and marking, flashing beacons, or signalized control. The ***Department's Standard Plans, Index No. 711-001*** provides three possible configurations of treatments for midblock crossings. Additional guidance on the application of selected signing, marking, and control treatments is provided through the remainder of this section. Additional treatments, not included in this section, may also be appropriate depending upon the individual site characteristics.

(3) For locations where signal warrants are met, consideration may be given to providing a pedestrian bridge or tunnel in lieu of an at-grade marked crossing. For further information, refer to the ***AASHTO Guide for the Planning, Design and Operation of Pedestrian Facilities***.

This approach may be appropriate at trail crossings where high volumes of recreational pedestrians and cyclists conflict with high speed vehicular volumes, as grade separation would significantly decrease delay and conflict points for all users.

(4) Pedestrian Traffic Control Signal

(a) When pedestrian volumes are of a sufficient level to meet signal warrants, a pedestrian traffic control signal may be installed to serve this demand. Applicable pedestrian signal warrants and installation guidelines are identified in ***Section 4C.05 of the MUTCD***. Considerations for a pedestrian traffic control signal at a new location should include distance to adjacent signals and availability of adequate gaps for pedestrians to cross the roadway. In some cases a pedestrian signal may not be needed at the study location if adjacent coordinated traffic control signals consistently provided gaps of adequate length for pedestrians to cross the roadway. The ***Department's MUTS*** provides additional guidance on conducting Pedestrian Group Size and Vehicle Gap Size studies.

(b) For locations where signalized control is selected for the pedestrian crossing, additional coordination for the crossing location is recommended with the District Access Management Review Committee and the District Traffic Operations Engineer.

(c) For six-lane roadways or crossing distances exceeding 80 feet, a two-stage pedestrian crossing should be considered where the proposed crossing will be controlled by a warranted pedestrian signal. A two-stage pedestrian crossing may have a lesser impact to vehicle delay (compared to a single crossing) since the signal serves each direction independently while the median serves as a refuge area for pedestrians to wait prior to completing their crossing.

(d) At locations where pedestrian compliance is of concern, feedback devices may be installed with the pedestrian signal button to provide pedestrians with confirmation of the call.

(5) Pedestrian Hybrid Beacon

(a) A possible alternative to the pedestrian traffic signal is the Pedestrian Hybrid Beacon (Figure 3.8.2). ***Chapter 4F of the MUTCD*** provides volume warrants and additional guidance on the use of Pedestrian Hybrid Beacon where pedestrian volumes do not meet the warrants for a pedestrian traffic signal under ***Section 4C.05 of the MUTCD***. This device is not intended for use at intersections or driveways, as MUTCD recommends maintaining a distance of 100 feet from side streets or driveways controlled by Stop or Yield signs.

(b) For six-lane roadways or crossing distances exceeding 80 feet, a two-stage pedestrian crossing should be considered where the proposed marked crossing will be controlled by a warranted pedestrian hybrid beacon. A two-stage pedestrian crossing may have a lesser impact to vehicle delay (compared to a single crossing) since the signal serves each direction independently while the median serves as a refuge area for pedestrians to wait prior to completing their crossing.

Figure 3.8.2. Pedestrian Hybrid Beacons

(6) Supplemental Beacons

For locations where full pedestrian traffic signals are not warranted, supplemental beacons may be considered to provide additional emphasis of the marked crosswalk and the presence of pedestrians. Two options are currently available for use: standard flashing yellow warning beacons and Rectangular Rapid Flashing beacons.

(a) Rectangular Rapid Flashing Beacons (RRFB)

- FHWA considers the RRFB to be highly successful for marked crosswalk applications at uncontrolled approaches. When installed at appropriate locations, RRFBs show high compliance rates at a lower cost than pedestrian signalization. Since the interim approval of this treatment ***(IA-11),*** these devices have been implemented across the country.

- The rectangular beacons are provided in pairs below the PEDESTRIAN CROSSING warning sign ***(W11-2)*** and operate in a "wig-wag" pattern upon activation by the pedestrian. When used, the beacons must be pedestrian activated, using approved detectors (such as pushbuttons or passive detection devices) that meet ADA requirements for accessibility. An example of the rectangular rapid flashing beacon treatment is shown in ***Figure 3.8.3***. Detailed conditions of use, including sign/beacon assembly, dimensions and placement, and flashing rates are provided in the July 16, 2008 policy memorandum ***(IA-11)*** and subsequent investigations by FHWA.

- Use of RRFBs should be limited to roadways with four or fewer through lanes.

- Any new RRFB on a multilane undivided roadway should be installed overhead unless design constraints or engineering documentation preclude overhead installation. Overhead RRFBs improve visibility for approaching drivers and are consistent with the installation of overhead school zone warning signs on multilane roadways. Consideration should be given to installing advanced warning signs with RRFBs on multilane approaches, especially those with higher traffic volumes and speeds.

- When overhead RRFBs are used, they should be combined with ground mounted devices. Overhead RRFBs should be feature an internally illuminated pedestrian crossing sign which is continuously lit at night.

Figure 3.8.3. Rectangular Rapid Flashing Beacons

(b) Flashing Yellow Warning Beacons

- The use of flashing yellow warning beacons may provide additional emphasis of the crossing location by supplementing the appropriate marked crossing warning or regulatory signs where pedestrian signals are not warranted. These devices are still an allowable in ***MUTCD***, although newer devices such as RRFBs have increased in popularity. When used, beacons shall meet the requirements of ***Chapter 4L of the MUTCD***. Any flashing yellow warning beacons installed at a new crosswalk at an uncontrolled location must use pedestrian actuation, as to elicit a more effective response from motorists than continuously flashing beacons.

- Beacons may be configured either overhead or side mounted; however, the preferred configuration is a side, post-mounting to avoid drivers confusing the beacons for a flashing traffic signal.

- When post mounted, a configuration of two vertically aligned warning beacons is recommended. These beacons should be operated in an alternating flash pattern.

- When beacons are overhead mounted, an internally illuminated pedestrian crossing sign should be used in conjunction with the beacons. This sign should be continuously lit at night.

(7) In-Roadway Lighting

(a) ***Section 4N.02 of the MUTCD, In-Roadway Pedestrian Warning Lights at Crosswalks*** establishes federal standards by which lighted (illuminated) pedestrian crosswalk edge lines can be installed and operated. Additional guidance and support are provided in ***Section 4N.02 of the MUTCD*** which may be used for the installation and operation of lighted in-roadway pedestrian crosswalks. These additional provisions may be reviewed and considered on a lighted pedestrian walkway.

(b) In-roadway warning lights shall not be used where YIELD or STOP signs, or traffic signals are present.

(8) Supplemental Signing and Markings

(a) To provide additional emphasis of the requirement to stop for pedestrians in the marked crosswalk, a stop bar and associated STOP HERE FOR PEDESTRIANS ***(R1-5 series)*** sign may be used. The following treatments are not to be used in combination with other active treatments such as the Pedestrian Hybrid Beacon.

- If used, the stop bar should be placed 40 ft in advance of the marked crosswalk. See ***Department's Standard Plans, Index No. 711-001***. Where a stop bar is used, parking should be prohibited in the area between the stop line and the marked crosswalk.

- If a stop line is provided, the corresponding STOP HERE FOR PEDESTRIANS ***(R1-5 series)*** sign shall be provided. The ***Department's Standard Plans, Index No. 711-001*** illustrates the placement of these signs. ***Section 2B.11 of the MUTCD*** provides additional guidance on the placement of the R1-5 series sign.

- An ADVANCE PEDESTRIAN CROSSING warning sign ***(W11-2)*** with supplemental AHEAD plaque shall be used in combination with the ***R1-5 series*** sign. The ***Department's Standard Plans, Index No. 711-001*** shall be used for mounting locations of advance ***W11-2*** signs as related to approach speeds.

(b) IN-STREET PEDESTRIAN CROSSING sign ***(R1-6 or R1-6a)*** may be used on low speed roadways to remind road users of laws regarding right-of-way at an unsignalized pedestrian crosswalk. An IN-STREET PEDESTRIAN CROSSING sign should not be placed in advance of a marked crosswalk to educate road users about the State law prior to reaching the marked crosswalk, nor should it be installed as an educational display along the highway that is not near any crosswalk. Additional information is provided in ***Section 2B.12 of the MUTCD***.

- If used, the IN-STREET PEDESTRIAN CROSSING signs shall be placed in the roadway at the marked crosswalk location on the center line, on a lane line, or on a median island. The IN-STREET PEDESTRIAN CROSSING sign shall not be post-mounted on the left-hand or right-hand side of the roadway.

3.8.7 SELECTION GUIDANCE FOR PEDESTRIAN TREATMENTS

(1) The treatment to be provided at a particular location should be selected in consideration of pedestrian volumes and crossing difficulty:

(a) For a high volume of crossing pedestrians, signal control is usually appropriate, provided an ***MUTCD*** signal warrant is satisfied.

(b) For locations that meet the criteria for identified need under ***Section 3.8.5***, but do not have sufficient pedestrian volume to meet ***MUTCD*** signal warrants, decisions about which additional treatment elements to include (if any) should be made with sound engineering judgment.

(c) In urban corridors featuring a coordinated signal system, a location that meets the pedestrian hybrid beacon criteria may be upgraded to a pedestrian traffic signal. In such cases, consideration should be given to cycle length, signal spacing and available gaps to reduce pedestrian delay and promote signal compliance.

(2) The charts shown in ***Figure 3.8.4*** and ***Figure 3.8.5*** of this section were developed using ***MUTCD Table for Figure 4C-7***, Tables for ***Figure 4F-1*** and ***Figure 4F-2*** respectively. The charts herein are intended for use as a quick-check guidance for selecting the appropriate pedestrian traffic control device for a particular set of hourly vehicular and pedestrian volumes for low and high-speed roadways.

Figure 3.8.4

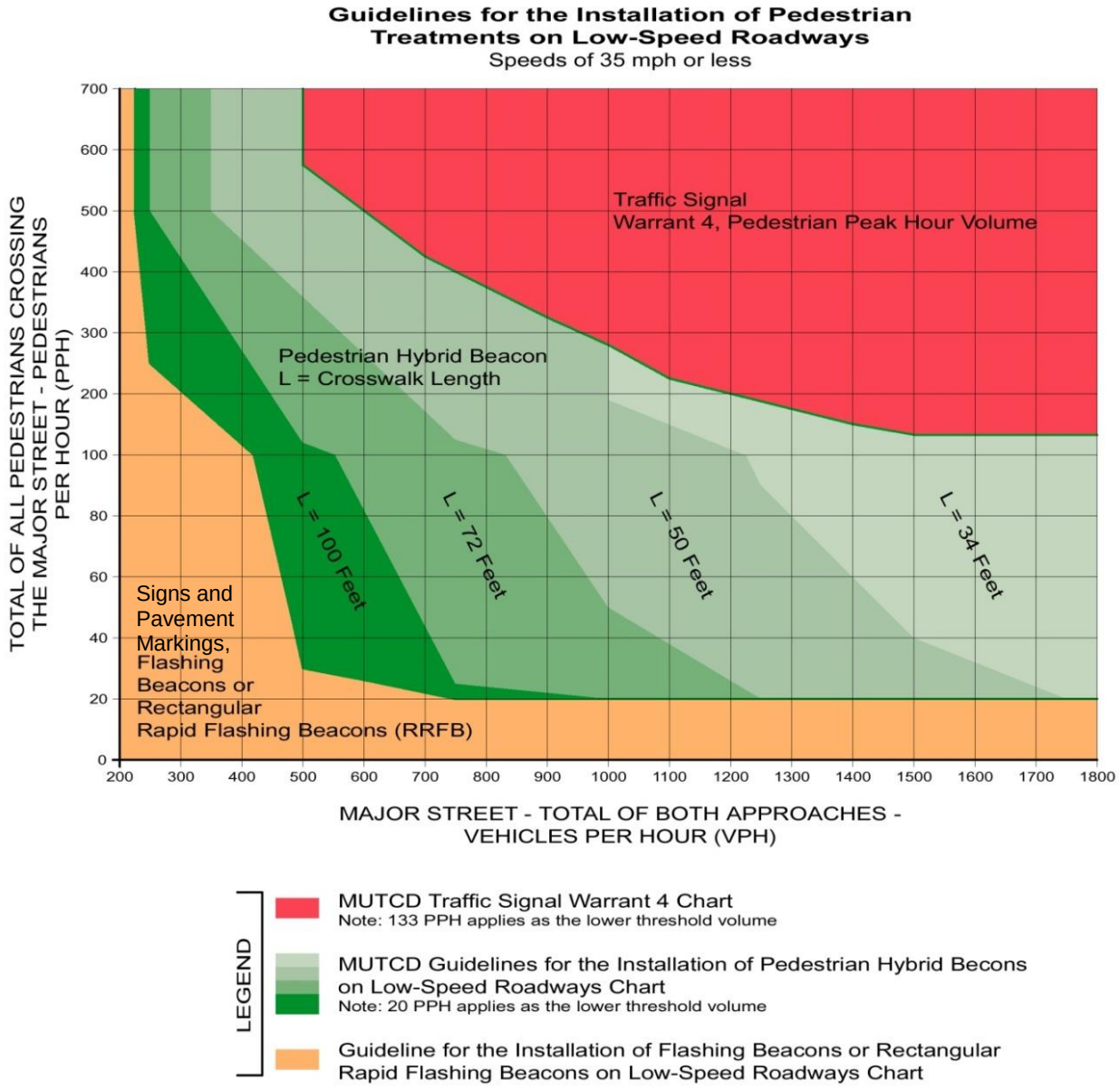
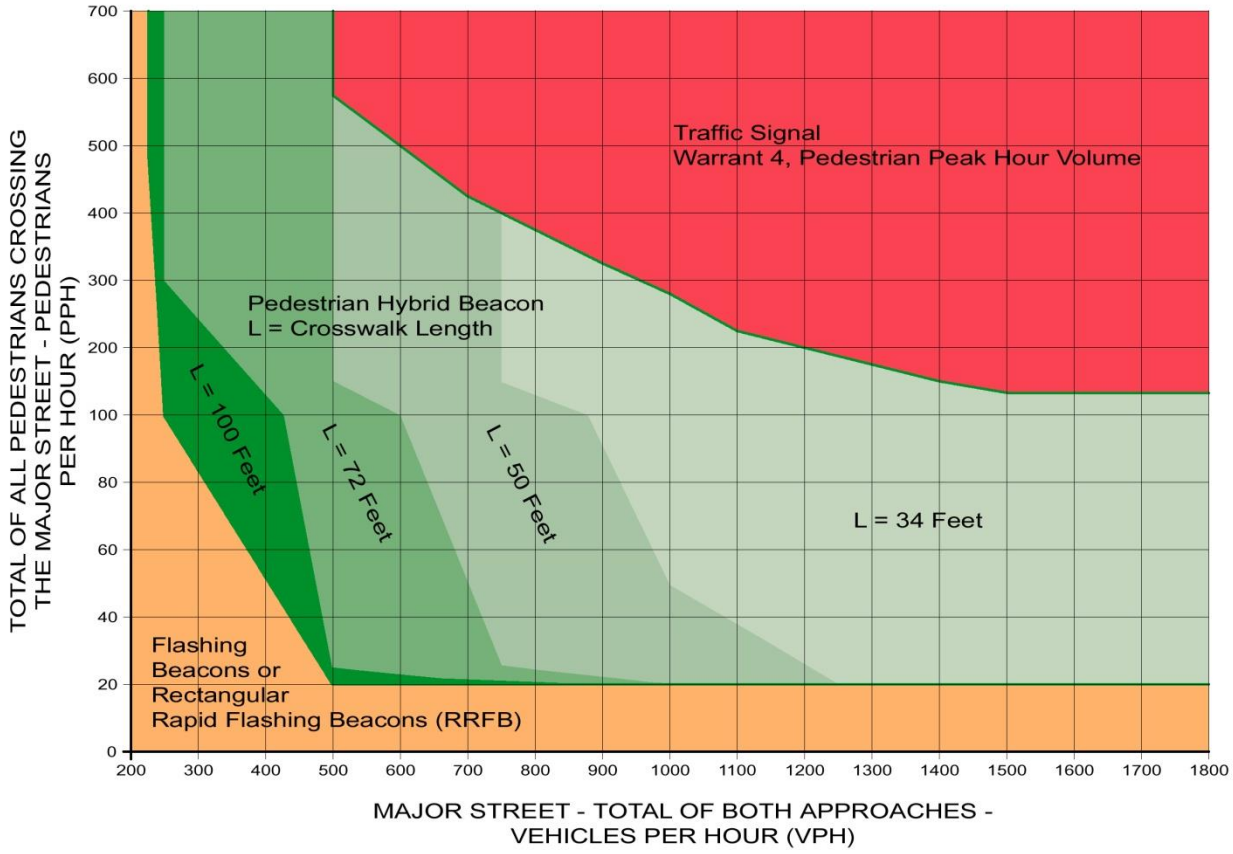

Guidelines for the Installation of Pedestrian Treatments on Low-Speed Roadways
Speeds of 35 mph or less
TOTAL OF ALL PEDESTRIANS CROSSING THE MAJOR STREET - PEDESTRIANS PER HOUR (PPH)
700
600
500
400
300
200
100
80
60
40
20
0
Traffic Signal
Warrant 4, Pedestrian Peak Hour Volume
Pedestrian Hybrid Beacon
L = Crosswalk Length
L = 100 Feet
L = 72 Feet
L = 50 Feet
L = 34 Feet
Signs and Pavement Markings, Flashing Beacons or Rectangular Rapid Flashing Beacons (RRFB)
200 300 400 500 600 700 800 900 1000 1100 1200 1300 1400 1500 1600 1700 1800
MAJOR STREET - TOTAL OF BOTH APPROACHES - VEHICLES PER HOUR (VPH)
LEGEND
MUTCD Traffic Signal Warrant 4 Chart
Note: 133 PPH applies as the lower threshold volume
MUTCD Guidelines for the Installation of Pedestrian Hybrid Becons on Low-Speed Roadways Chart
Note: 20 PPH applies as the lower threshold volume
Guideline for the Installation of Flashing Beacons or Rectangular Rapid Flashing Beacons on Low-Speed Roadways Chart

Figure 3.8.5

Guidelines for the Installation of Pedestrian Treatments on High-Speed Roadways
Speeds greater than 35 mph



LEGEND

- MUTCD Traffic Signal Warrant 4 Chart
  Note: 133 PPH applies as the lower threshold volume
- MUTCD Guidelines for the Installation of Pedestrian Hybrid Becons on High-Speed Roadways Chart
  Note: 20 PPH applies as the lower threshold volume
- Guideline for the Installation of Flashing Beacons or Rectangular Rapid Flashing Beacons on High-Speed Roadways Chart

Section 3.9

COUNTDOWN PEDESTRIAN SIGNAL APPLICATIONS

This section was rescinded on 11/1/17.